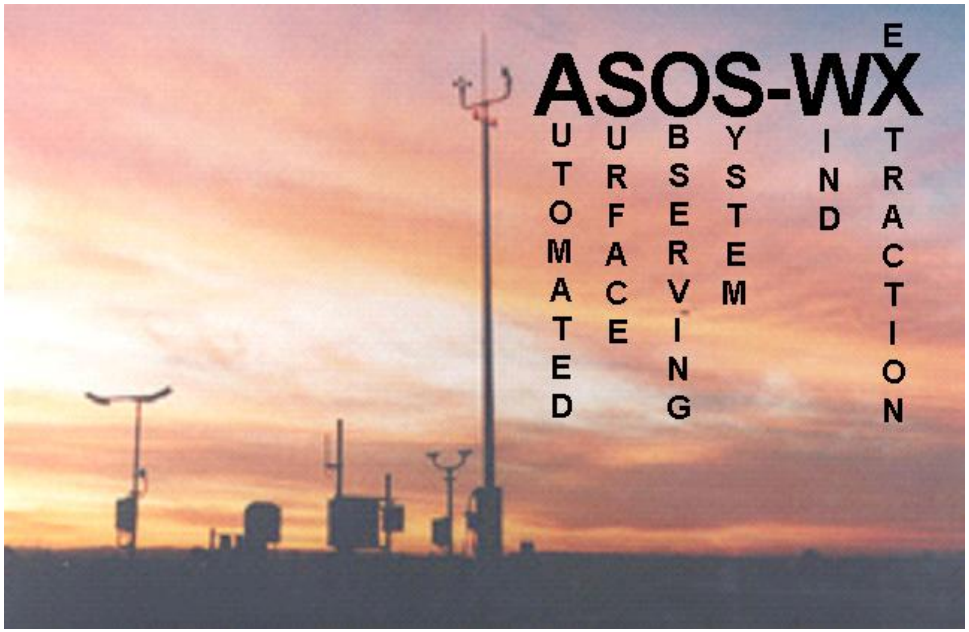
Documentation for **ASOS-WX** Software



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Overview

ASOS-WX is a MATLAB-based[1,2] software tool for extraction of wind and thunderstorm data from ASCII-format Automated Surface Observing System (ASOS) data files for use in extreme value analyses. Within the software, one or more ASOS files can be selected for analysis, and the software can then perform the following actions for all selected files:

1. Extraction of peak gust wind data (speed, direction, and date/time)
2. Extraction of thunderstorm reports (beginning and end times, manual thunderstorm observations)
3. Classification of wind data as "Thunderstorm" or "Non-Thunderstorm" (to enable separate statistical analysis)
4. Construction of data sets separated by specified minimum time intervals (to ensure statistical independence)

The selected output results are written as comma-delimited text files (*.csv), which can be readily opened in standard spreadsheet software for further analysis and plotting.

The **ASOS-WX** software is available for download at www.nist.gov/wind, by following the link for "Extraction of wind data from ASOS records". At this **ASOS-WX** website, the software is available either as MATLAB m-files, for execution within MATLAB, or as a stand-alone executable. The **ASOS-WX** software was developed and tested in the Microsoft Windows environment using version 7 of MATLAB. It is believed that the MATLAB m-files can be ported to non-Windows (e.g., Linux/Unix) environments with minimal changes. For execution within MATLAB, the folder containing the downloaded **ASOS-WX** m-files must be added to the MATLAB search path, and the software can then be launched by typing "asos_wx" at the MATLAB command prompt.

A "stand-alone" version of the software is also available at the **ASOS-WX** website, for users who do not have MATLAB version 7 and are running in the Windows 2000/XP environment. This stand-alone version requires installation of the MATLAB Component Runtime (MCR) Libraries provided by The MathWorks, Inc. The MCR Libraries are available for download[3] at the **ASOS-WX** website as a self-installing executable named "MCRInstaller.exe". The stand-alone executable files are available for download at the **ASOS-WX** website as a single self-extracting zip file named "stand-alone.exe". Execution of this file will create a folder named "stand-alone", and the **ASOS-WX** software can then be launched by executing the application "ASOS_WX.exe" within this folder.

More information about ASOS itself can be found in the ASOS User's Guide from NOAA, and ASCII-format ASOS records can be obtained directly from NOAA, for a fee. To enable users to evaluate this software, a sample ASOS record (HAS0000826915.op) is provided for download at the **ASOS-WX** website, containing data from two different airports in the New York City area:

- Station 725020: Newark International Airport (13 months of data)
- Station 725030: New York LaGuardia Airport (39 months of data)

Also provided for download at the **ASOS-WX** website is a file named WBAN-MSC.TXT, which was obtained from the Surface Inventories Page on the NOAA website. This file contains station identification numbers and descriptive names for weather stations around the world, including ASOS stations in the United States. This file is used by the **ASOS-WX** software for identification of stations encountered in ASOS files.

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[1] MATLAB®. © 1984 – 2005 The Mathworks, Inc.

[2] Certain trade names or company products are mentioned in the text to specify adequately the procedure used. Such identification does not imply recommendation or endorsement by NIST, nor does it imply that the product is the best available for the purpose.

[3] The authors' limited rights to the deployment of this program are limited by a license agreement between NIST and The MathWorks. The license agreement can be found at www.mathworks.com/license/. The authors, NIST, and The MathWorks and its licensors are excluded from all liability for damages or any obligation to provide remedial actions.

Matlab M-files

The **ASOS-WX** software consists of the following nine MATLAB functions, which are further described subsequently:

- asos_wx: The main function, which calls the other functions
- PK_WND: Extracts peak gust wind data from ASOS files
- MW: Extracts manual thunderstorm observations from ASOS files
- tsBE: Extracts thunderstorm beginning and end times from ASOS files
- case_time: Determines the date and time of a peak wind or thunderstorm beginning/end report using relevant information from the current line of the ASOS file
- interval_sep: Constructs data sets separated by at least the specified time interval, to ensure statistical independence
- set_ts_windows: Opens a dialog box in which users can specify lengths of time for extending thunderstorm windows, for classification of "Thunderstorm" and "Non-Thunderstorm" winds
- set_sep_intervals: Opens a dialog box in which users can specify time intervals by which "Thunderstorm" and "Non-Thunderstorm" winds must be separated to ensure statistical independence
- ASOS_id: Extracts ASOS station numbers and descriptive names from WBAN-MSC.TXT, a text file provided by NOAA

Each function is available for download as a MATLAB m-file with the same name as the function and a ".m" file extension.

asos_wx

This is the main function of the **ASOS-WX** software, and it calls a number of other functions that are described subsequently. The flow of the analysis within the *asos_wx* function is as follows:

1. A dialog box is opened that prompts the user to select one or more ASOS files for analysis.
2. The PK_WND function is called to extract peak wind speed observations from each of the selected ASOS files, along with their corresponding wind direction, date/time, and ASOS station code. The PK_WND function calls the case_time function to determine the date/time of each peak wind observation using relevant information on the current line.
3. A dialog box is opened that prompts the user to select one ASOS station from a list of stations (with both station numbers and descriptive names) for which peak wind observations were identified in the selected files. Descriptive names corresponding to the reported ASOS station numbers are obtained using the ASOS_id function.
4. The user is prompted to select which of the following output files should be written:

(A) All winds	(filename: "station_######_ALL.csv")
(B) Non-thunderstorm winds	(filename: "station_######_NTS.csv")
(C) Thunderstorm winds	(filename: "station_######_TS.csv")
(D) Non-thunderstorm winds, separated by specified time interval	(filename: "station_######_NTS_sep.csv")
(E) Thunderstorm winds, separated by specified time interval	(filename: "station_######_TS_sep.csv")
(F) Manual thunderstorm observations	(filename: "station_######_MW.csv")
(G) Thunderstorm beginning and end times	(filename: "station_######_tsBE.csv")

5. A dialog box is opened that prompts the user to select a location for writing the specified output files.
6. If any of output files (B) through (G) are selected, then the MW function is called to extract manual thunderstorm observations (date/time and code) for the specified ASOS station from the selected files.

7. If any of output files (B) through (E) or (G) are selected, then the tsBE function is called to extract the date/times of reported thunderstorm beginnings and ends for the specified ASOS station from the selected files. The tsBE function calls the case_time function to determine the date/time of each reported thunderstorm beginning and end using relevant information on the current line. The tsBE function returns lists of "unmatched" beginning and end times, for which corresponding end and beginning times were not found, and these "unmatched" times are compared with the manual thunderstorm observations (from step 5) to determine whether they represent legitimate thunderstorms. "Unmatched" beginning times are considered legitimate if they occur within an hour previous to a manual thunderstorm observation, and "unmatched" end times are considered legitimate if they occur within an hour after a manual thunderstorm observation.
8. If any of output files (B) through (E) are selected, then the following steps are performed:
    a. The function set_ts_windows is called, which opens a dialog box prompting the user to specify windows of time to extend thunderstorm durations before and after the reported beginning and ending times, for identification of thunderstorm winds.
    b. The times of the peak wind observations are used in conjunction with the reported thunderstorm beginning and end times to classify the peak winds as "Thunderstorm" or "Non-Thunderstorm". For "unmatched" beginning and end times, the corresponding end and beginning times are estimated by assuming a thunderstorm duration equal to the 90th percentile of the thunderstorm durations computed from the matching beginning and end times.
9. If output file (D) or (E) are selected, then the following steps are performed:
    a. The function set_sep_intervals is called, which opens a dialog box and prompts the user to specify minimum time intervals by which "Thunderstorm" and "Non-Thunderstorm" winds should be separated in order to ensure statistical independence. Different separation intervals can be specified for "Thunderstorm" and "Non-Thunderstorm" winds.
    b. The function interval_sep is called separately for "Thunderstorm" and/or "Non-Thunderstorm" winds to obtain peak wind speed, wind direction, and date/time values separated by at least the time intervals specified in the previous step.
10. The specified output files are written in comma-delimited format (*.csv), and a dialog box is opened to inform the user of the names of the files that have been written. Output files (A) through (E) each contain three columns of data, giving the date/time, wind speed, and wind direction for the selected type of winds. Output file (F) contains two columns of data giving the date/time and code of each manual thunderstorm observation (descriptions for the thunderstorm codes are given in a table in the description of the MW function). Output file (G) contains five different sections, and their contents are as follows. Section I contains three columns giving the beginning date/time, end date/time, and computed duration of each thunderstorm for which matching beginning and end reports were identified. Section II contains three columns giving the reported beginning date/time, *estimated* end date/time, and *estimated* duration for "unmatched" thunderstorm beginning reports that were determined to be legitimate by comparison with manual thunderstorm observations (step 7 above). Similarly, Section III contains three columns giving the *estimated* beginning date/time, reported end date/time, and *estimated* duration for "unmatched" end times that were determined to be legitimate by comparison with manual thunderstorm observations (step 7 above). The estimated duration used in Sections II and III is the 90th percentile of the computed durations reported in Section I. Section IV contains a single column giving the date/time of "unmatched" thunderstorm beginning reports that were rejected upon comparison with manual thunderstorm observations. Similarly, Section V contains a single column giving the date/time of "unmatched" end reports that were rejected upon comparison with manual thunderstorm observations. Output files (A) through (G) each contain several header rows that provide the ASOS filename(s) from which data were extracted, the ASOS station number with a descriptive name, and the type of output file. Output files (B) through (G) also contain additional header rows with information that is relevant to the results in the particular output file.

PK_WND

Syntax: `[ws, wd, date_time, station_id] = PK_WND(full_filename)`

Description:

This function extracts peak gust wind data from the selected ASOS file. The standard format for reporting peak wind gusts in ASOS files is as follows: "PK WND **dddss(s)/(hh)mm**", where **ddd** represents three numeric characters giving the wind direction in degrees, **ss(s)** represents either two or three numeric characters giving the wind speed in knots (three characters are used only if the wind speed exceeds 99 knot), and **(hh)mm** represents either two or four numeric characters giving the time of the report. Prior to the stations becoming fully automated, peak winds were reported as "PK WND **D(D)ss(s)/(hh)mm**", where "**D(D)**" represents either one or two numeric characters giving the wind direction in tens of degrees; e.g., 270° would be indicated as "27" while 90° would be indicated as "9". The existence of these various possible coding formats for wind speed and direction presents a challenge in the interpretation of peak wind reports. The total number of digits preceding the slash can range from three to six, and the following table summarizes the rules that are applied in interpreting the wind speed and direction depending on the number of digits encountered:

Number of Digits	Interpretation
<3	*ambiguous* ➔ *rejected*
3	**Dss**
4	if 1st digit >3 or 3rd digit ≤ 1 (see note 1) ➔ **Dsss** otherwise (see note 2) ➔ **DDss**
5	if 3rd digit = 0 (see note 3) ➔ **dddss** if 3rd digit = 1 ➔ **DDsss** otherwise (see note 4) ➔ *ambiguous* ➔ *rejected*
6	**dddsss**
>6	*ambiguous* ➔ *rejected*

Notes:

1. The wind direction cannot be greater than 360°, and wind speeds of less than 25 knot are not reported.
2. The case of 4 digits is actually ambiguous if the 1st digit ≤ 3, the 3rd digit > 1, and the 2nd digit ≤ 1; e.g., "3145" could be interpreted as a speed of 45 knot at 310° (**DDss**) or as a speed of 145 knot at 30° (**Dsss**). However, the latter interpretation is much less plausible, and such an interpretation is only possible for a wind speed exceeding 119 knot with a direction between 0° and 30°. Such an occurrence is considered sufficiently improbably that the **DDss** interpretation is adopted for all 4-digit cases in which the 1st digit ≤ 3 and the 3rd digit > 1.
3. Wind directions are reported in increments of 10°.
4. Wind speeds in excess of 199 knot are not considered a realistic possibility and are rejected.

Two digits are generally used to represent the time (**mm**) if the peak gust occurred within the hour previous to the time reported at the start of the data line, while four characters are used (**hhmm**) if the peak gust occurred more than an hour previously. The case_time function is called to determine the date and time of each peak gust from the two- or four-digit time code and the date and time reported near the start of the data line.

Variants of the "PK WND" coding (e.g., "PKWND" or "PK WNDS") are sometimes encountered in ASOS data files. Since the "PK" code is not used for reporting any other information in ASOS files, the PK_WND function searches for only the string "PK", followed within 30 characters

on the same line by a slash (“/”). The consecutive numerical characters preceding the slash are taken to represent the wind speed and direction, interpreted as indicated in the table above, and the numerical characters following slash are taken to represent the time.

A fairly commonly encountered error in the reporting of peak gust winds in ASOS files is the repetition of a “PK WND” report on subsequent lines without switching from the **mm** time format to the **hhmm** format. Because the time at the start of the line is used to determine the hour of each report, such repetitions would be misinterpreted as a new event occurring at a later hour. To avoid such errors, the PK_WND function ignores reports in which the same wind speed and time code are repeated within an interval of two hours, unless a different wind speed is reported between the two. Another error that is sometimes encountered is a time code having other than two or four digits. The time cannot be interpreted unambiguously in such cases, so the time reported at the start of the line is used for the peak wind. However, if the ambiguous time code is reported within two hours of a previous “PK WND” report having the same wind speed, then the ambiguous report is assumed to be a repetition and is ignored.

Input Arguments:

`full_filename`	A string containing the entire pathname and filename of the ASOS record to be analyzed (e.g., “C:\ASOSfiles\HAS0000826915.op”).

Output Arguments:

`ws`	A vector of peak wind speed values reported in the selected file.
`wd`	A corresponding vector of wind direction values reported in the selected file.
`date_time`	A corresponding vector of serial date numbers (returned by the MATLAB *datenum* function) giving the date and time of each peak wind report.
`station_id`	A corresponding vector of numerical values (six-digit codes used by NOAA) that defines the ASOS station for each peak wind report. This output argument enables handling of ASOS files containing data from more than one station.

MW

Syntax: `[MW_date_time, MW_code] = MW(full_filename, station_id)`

Description:

This function extracts manual thunderstorm observations for the specified ASOS station from the selected file. Manual weather observations are indicated in ASOS data files by the characters "MW" followed by three numeric characters. The first of these numeric characters is simply a counter to indicate the number of manual weather observations on the current data line (e.g., the first manual weather observation on a given line begins with "MW1", the second with "MW2", and so on). The second and third of these numeric characters are a code that represents the type of weather in progress at the time of the current report. As shown in the following table, seven different codes are available for indicating a thunderstorm in progress, and this function searches for all occurrences of any of these codes.

Code	Description
17	Thunderstorm, but no precipitation at time of observation
29	Thunderstorm (with or without precipitation)
95	Thunderstorm, slight or moderate, without hail, but with rain and/or snow at time of observation
96	Thunderstorm, slight or moderate, with hail at time of observation
97	Thunderstorm, heavy, without hail, but with rain and/or snow at time of observation
98	Thunderstorm, combined with duststorm or sandstorm at time of observation
99	Thunderstorm, heavy, with hail at time of observation

The date and time of each report are obtained from the information provided near the start of the data line, and this function returns the date/time of each manual thunderstorm observation (output argument `MW_date_time`) along with the code from the table above used for each observation (output argument `MW_code`).

Input Arguments:

`full_filename` A string containing the entire pathname and filename of the ASOS file to be analyzed (e.g., "C:\ASOSfiles\HAS0000826915.op")

`station_id` A numerical value (six-digit code used by NOAA) that defines the ASOS station for which manual thunderstorm observations are to be extracted from the selected file. This input argument enables handling of ASOS files containing data from more than one station.

Output Arguments:

`MW_date_time` A vector of serial date numbers (returned by the MATLAB *datenum* function) giving the date and time of each manual thunderstorm observation.

`MW_code` A corresponding vector of numerical values giving the code (from the table above) for each thunderstorm observation.

tsBE

Syntax: `[B_date_time, E_date_time, umB_date_time, umE_date_time] = tsBE(full_filename, station_id)`

Description:

This function extracts reported thunderstorm beginning and end date/times for the specified ASOS station from the selected file. Thunderstorm beginning times are reported in ASOS files using the codes "TB" or "TSB" followed by a two-digit or four-digit time code, which represents the minute of the report as **mm** or the hour and minute of the report as **hhmm**. Thunderstorm end times are reported in a similar manner using the codes "TE" of "TSE" followed by a two- or four-digit time code. Four digits are generally used when the time of occurrence was more than an hour before the time of the current report. The date and time of the current report are given near the start of each line in an ASOS file, and the function case_time is called to determine the time of each beginning or end report from the two- or four-digit time code and the date and time reported at the start of the line. Thunderstorm beginning and end times are also sometimes reported in alternation by using a "B" and an "E" to denote subsequent beginning and end times (e.g., "TSB12E57", "TSE1245B13", or "TSB2135E11B47"). In some cases a space may appear between the thunderstorm beginning or end code and the numerical characters, and the variants "T B" and "T E" are also sometimes encountered to denote a thunderstorm beginning and end, respectively. This function extracts beginning and end times reported in any of these possible formats.

A fairly commonly encountered error in the reporting of thunderstorm beginning and end times in ASOS files is the repetition of a time code on subsequent lines without switching from the **mm** time format to the **hhmm** format. Because the time at the start of the line is used to determine the hour of each report, such repetitions would be misinterpreted as a new event occurring at a later hour. To avoid such errors, the tsBE function ignores reports in which the same time code is repeated for a beginning (or end) within two hours of a previous beginning (end) report, unless a different beginning (end) time code occurs between the two. Another error that is sometimes encountered is a time code having other than two or four digits (e.g., "TSB123" or "TE7"). The time cannot be interpreted unambiguously in such cases, so the time reported at the start of the line is used for the thunderstorm beginning or end. However, if an ambiguous thunderstorm beginning (or end) report occurs within two hours of a previous thunderstorm beginning (end), then the ambiguous report is assumed to be a repetition and is ignored.

Once all thunderstorm beginning and end times have been extracted from the selected file (excluding those identified as repetitions), the function then loops through the list of beginning times (output argument `B_date_time`) and identifies an end time corresponding to each (output argument `E_date_time`). If no corresponding end time is identified for a reported beginning time, then the beginning time is deleted from the list and stored in an "unmatched" beginning times list (output argument `uB_date_time`). Similarly, if an end time is identified with no corresponding beginning time, then the end time is deleted and stored in an "unmatched" end times list (output argument `uE_date_time`).

The procedure for identifying matching beginning and end times proceeds as follows: The first beginning time, `B_date_time(1)`, is compared with the first end time, `E_date_time(1)`. If `E_date_time(1) > B_date_time(1)` (i.e., the beginning precedes the end), then the function moves on to compare `B_date_time(2)` with `E_date_time(2)`, and so on. If `E_date_time(k) < B_date_time(k)`, then it is assumed that the beginning time corresponding to `E_date_time(k)` is missing, and `E_date_time(k)` is deleted and added to `uE_date_time`. If `E_date_time(k) - B_date_time(k) > 12/24` (i.e., a thunderstorm duration of more than 12 h), then it is assumed that the ending time corresponding to `B_date_time(k)` is missing, and `B_date_time(k)` is deleted and added to `uE_date_time`. If `k>1`, then `B_date_time(k)` is also compared with the previous end time, `E_date_time(k-1)`. If `B_date_time(k) < E_date_time(k-1)`, then `B_date_time(k)` is assumed to be an erroneously repeated beginning time, and it is deleted and added to `uB_date_time`. Finally, when the last element of either `B_date_time` or `E_date_time` is reached, any remaining elements in the longer vector are deleted and added to the appropriate "unmatched"

times list. This procedure ensures that the vectors `B_date_time` and `E_date_time` have the same length, with the duration of the k^{th} thunderstorm being given by `E_date_time(k) - B_date_time(k)`.

When the vectors of matching beginning and end times (`B_date_time` and `E_date_time`) have been assembled in this manner, then all of the "unmatched" beginning and end times (`uB_date_time` and `uE_date_time`) are checked to ensure that they are sufficiently separated from the matching thunderstorm times to be considered separate events. Elements are eliminated from `uB_date_time` and `uE_date_time` if they fall within a window extending from 15 min before any thunderstorm beginning to 15 min after the matching thunderstorm end.

Input Arguments:

`full_filename` A string containing the entire pathname and filename of the ASOS file to be analyzed (e.g., "C:\ASOSfiles\HAS0000826915.op")

`station_id` A numerical value (six-digit code used by NOAA) that defines the ASOS station for which thunderstorm beginning and ending times are to be extracted from the selected file. This input argument enables handling of ASOS files containing data from more than one station.

Output Arguments:

`B_date_time` A vector of serial date numbers (returned by the MATLAB *datenum* function) giving the date and time of each thunderstorm beginning report for which a corresponding thunderstorm end report has been identified

`E_date_time` A corresponding vector of serial date numbers giving the date and time of each thunderstorm end report for which a corresponding beginning report has been identified. The length of `E_date_time` is the same as the length of `B_date_time`, and the duration of the k^{th} thunderstorm (in days) is given by the following MATLAB expression: `E_date_time(k) - B_date_time(k)`

`uB_date_time` A vector of serial date numbers giving the date and time of "unmatched" thunderstorm beginning reports, for which no corresponding thunderstorm ending time was found

`uE_date_time` A vector of serial date numbers giving the date and time of "unmatched" thunderstorm end reports, for which no corresponding thunderstorm beginning time was found

case_time

Syntax: `date_time = case_time(time_str, line_datestr)`

Description:

This function is called by both the PK_WND and tsBE functions, and it determines the date and time of a peak wind or thunderstorm beginning/end observation using relevant information from the current line of the ASOS file. Relevant information includes the date and time reported near the start of the current data line (input argument `line_datestr`) and the time reported for the peak wind or thunderstorm beginning/end observation itself (input argument `time_str`). Most commonly `time_str` contains only two characters, representing the minute of the observation; in some cases `time_str` may contain four characters, representing both the hour and the minute. The date (and in most cases the hour as well) must be inferred from the information contained in `line_datestr`. This inference is made by noting that the time represented by `time_str` must precede the time represented by `line_datestr`, because `line_datestr` represents the time that the current weather report was written. If the number of characters in `time_str` does not equal two or four, then its meaning is ambiguous. In such cases the date and time in `line_datestr` are returned in the output argument `date_time`. The following table illustrates several different scenarios in which the output argument `date_time` is determined from different values of the input arguments:

line_datestr	**time_str**	**date_time** (converted to 'datestr' format)
199911221051	37	22-Nov-1999 10:37:00
199911221051	57	22-Nov-1999 09:57:00 (previous hour)
199911221051	0937	22-Nov-1999 09:37:00
199911220042	53	21-Nov-1999 23:53:00 (previous day)
199911220042	123 (ambiguous)	21-Nov-1999 00:42:00

Input Arguments:

`time_str` A string representing the time of the observation. Either 2 or 4 numeric characters are expected, representing the minute of the report as **mm** or the hour and minute of the report as **hhmm**.

`line_datestr` A string of 12 numeric characters representing the year, month, day, hour, and minute of the current weather report as **YYYYMMDDhhmm**. For example, November 22, 1999 at 04:00 appears as "199911220400".

Output Arguments:

`date_time` A serial date number (returned by the MATLAB *datenum* function) giving the date and time inferred for the observation

interval_sep

Syntax: `[ws_sep, date_time_sep, ind_sep] = interval_sep(ws, date_time, interval)`

Description:

This function constructs data sets in which all values are separated by at least the specified time interval, in an effort to ensure statistical independence. Values that are less than or equal to neighboring values are eliminated as needed, in order to achieve the specified minimum separation interval.

The separation procedure works as follows: The time of the first peak wind speed in the list, `date_time(1)`, is checked against the time of the second peak wind speed, `date_time(2)`. If `date_time(2) – date_time(1) • interval`, then the `interval_sep` function moves forward to check `date_time(3) – date_time(2)`, and so on. If `date_time(k+1) – date_time(k) < interval`, then the lesser of the two wind speeds corresponding to those times is eliminated, and the greater is retained. If `ws(k+1) = ws(k)`, then `ws(k+1)` is eliminated and `ws(k)` is retained, because `ws(k)` has a larger separation interval from subsequent peak winds. When a wind speed value is eliminated, the corresponding `date_time` value is eliminated as well, and the `interval_sep` function then compares the surviving `date_time` value with the next value in the list. This procedure is continued through the entire time history, to ensure that all of the data points are separated by at least the specified time interval. The indices of the surviving data points are also returned by the function, so that a corresponding vector of wind direction values can be assembled if required.

Input Arguments:

`ws`	A vector of peak wind speed values
`date_time`	A corresponding vector of serial date numbers (returned by the MATLAB function *datenum*) giving the date and time of each peak wind speed value in the vector `ws`
`interval`	Minimum time interval (in days) by which output data must be separated (does not need to be an integer)

Output Arguments:

`ws_sep`	A vector of peak wind speed values separated from neighboring values by at least the specified interval
`date_time_sep`	A corresponding vector of serial date numbers giving the date and time of each peak wind speed in the vector `ws_sep`
`ind_sep`	A vector giving the indices of the surviving data points; `ws` and `ws_sep` are related by the following MATLAB expression: `ws_sep = ws(ind_sep)`. If `wd` represents a vector of wind direction values corresponding to `ws`, then a vector of separated wind direction values corresponding to `ws_sep` can be obtained using the following MATLAB expression: `wd_sep = wd(ind_sep)`.

set_ts_windows

Syntax: `[wind_pos, wind_neg, ok] = set_ts_windows`

Description:

This function opens a dialog box in which the user can specify the lengths of time to extend thunderstorm windows before and after the recorded beginning and end times. Peak winds reported within these extended thunderstorm windows are classified as “Thunderstorm” winds by the asos_wx function.

Input Arguments: *None*

Output Arguments:

`wind_pos`	Length of time (in days) to extend thunderstorm windows after the recorded thunderstorm end
`wind_neg`	Length of time (in days) to extend thunderstorm windows before a recorded thunderstorm beginning
`ok`	A flag that indicates whether the user pressed “OK” (`ok` = 1) or “Cancel” (`ok` = 0).

set_sep_intervals

Syntax: `[interval_nts, interval_ts, ok] = set_sep_intervals`

Description:

This function opens a dialog box in which the user can specify the minimum time intervals by which non-thunderstorm and thunderstorm wind speeds should be separated to ensure statistical independence. The intervals specified here are used as input arguments for the interval_sep function.

Input Arguments: *None*

Output Arguments:

`interval_nts`	Time interval for separation of non-thunderstorm winds
`interval_ts`	Time interval for separation of thunderstorm winds
`ok`	A flag that indicates whether the user pressed “OK” (`ok` = 1) or “Cancel” (`ok` = 0).

ASOS_id

Syntax: `[station_id, station_dn] = ASOS_id`

Description:

The purpose of this function is to obtain descriptive names corresponding to the station numbers that are reported in ASOS files. These descriptive names are used by the asos_wx function to notify the user of which stations were found in the selected ASOS files. *ASOS_id* obtains a list of ASOS station numbers and corresponding descriptive names by reading the file WBAN-MSC.TXT, which is available for download at the **ASOS-WX** website and can also be obtained through the Surface Inventories Page on the NOAA website. A dialog box prompts the user to select this file. If the file selection is cancelled or if errors are encountered in reading the file, then the user is warned that descriptive station names will be unavailable, and `ASOS_id` returns with empty output arguments. If the file is read successfully, then the output arguments `station_id` and `station_dn` are saved in a MATLAB MAT-file named "ASOS_stations.mat" in the default directory, in addition to being returned by `ASOS_id`. In subsequent analyses, `station_id` and `station_dn` can then be accessed more efficiently by simply loading "ASOS_stations.mat" rather than using this function. Before calling *ASOS_id*, asos_wx checks whether the file "ASOS_stations.mat'" exists and loads this file if it does.

Input Arguments: *None*

Output Arguments:

`station_id`	A vector of ASOS station numbers (six-digit codes used by NOAA)
`station_dn`	A corresponding cell array of strings containing descriptive names for each ASOS station